Anesthesia complications in the dental office
Anesthesia complications in the dental office

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To my family, with special remembrance for my Dad, S. Richard Bosack, DDS (1921–2011), to whom I promised this dedication.
Robert C. Bosack

To my family, teachers, and students; but most importantly to the patients who have trusted me with their care.
Stuart Lieblich
In memory of John Yagiela, DDS (1947 – 2010).
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Foreword

The publication Anesthesia Complications in the Dental Office covers a wide range of topics beneficial to all levels of anesthesia care providers, be they students, residents, academics, or clinical practitioners. The book begins with the preoperative issues that play a role in evaluating the difficulties in safeguarding the patients, many of whom present with medical problems that were far less common a couple of years ago. Modern medicine has extended our longevity but now the patients present to our offices with an extended list of medications for diseases that were less recognized in the past decades and they are often diagnosed with behavioral and obesity issues.

Pharmacology of anesthesia practice has frequently met the challenges of modern societal problems with newer, more efficient shorter acting agents than what was available in the 1960s and 1970s. These are discussed in the middle chapters of the book. While basic physiology has not changed much, our understanding of the new drugs available and the way they affect the safety of patients under anesthesia has. Since the 1980s, monitoring the effects of all anesthesia drugs with pulse oximetry, capnography, and even bispectral analysis for special situations has set the scene for improved safety.

Despite the improvement in airway management techniques and skills learned, complications, both common and far less common, are still of great concern. The final chapters in the book deal with the need for prompt recognition and treatment of anesthesia-related urgencies and emergencies. While death “is not an option” so to speak, it is discussed and put in proper perspective when comparing the risks of air travel, driving, and even exercising to those of undergoing anesthesia in the office.

This first edition of Anesthesia Complication in the Dental Office offers a wide variety of subject material and should be on the library shelf of every anesthesia care provider working in the dental office. The names of the contributors are well known in academia and in clinical practice and have great credibility in the field of office-based anesthesia practice to make this book worthy of acquiring.

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Anesthesia is a unique discipline in dentistry. We all take it for granted, yet little can be done without it. The only time we ever really pay attention to it is when it does not work as planned. Anesthetic complications, which range from simple annoyances to patient mortality, are inevitable, given the many and complex interactions of doctor, patient, personnel, and facility. Our intent is to minimize the frequency and severity of adverse events, by providing concise and clinically relevant information that can be put to everyday use.

This book is intended for all dental professionals, who already have a working knowledge of anesthesia at their level of practice. Most of the 10 sections are relevant to all levels of anesthesia practice – including patient risk assessment (Section II) and a review of common pathophysiologic problems (Section III). The review of anesthetic agents includes chapters on local anesthesia, nitrous oxide analgesia, and both enteral and parenteral agents. Emphasis in Section IV is placed on pharmacology, with the hope that appropriate and successful use of these agents will limit adverse and sometimes unexpected side effects. Sections V–X are more relevant to parenteral techniques, with the notable exception of the robust Chapter (31) on problems associated with the use of local anesthesia. We were pleased to have the opportunity to review the Standing Medical Orders of the Emergency Medical System from a major metropolitan region. Knowing what paramedics would do when called validated our recommendations for the initial management of anesthesia-related emergencies.

The appendices contain an interesting submission on crisis resource management by an airline pilot. We have learned much from the groundbreaking safety protocols that have transformed the airline industry. A brief emergency manual, suitable for general practitioners, has also been provided.

We have taken several liberties with this publication. Focus has been directed to the office setting, with its obvious and inherent limits on diagnosis and treatment. We have used the words anesthesia and sedation interchangeably, with the understanding that drug use may be limited by training or license. Wherever possible, we have attempted to include references to key or seminal articles, to provide direction to those practitioners seeking further information.

Over the years, we have been given the wonderful opportunity to present to and interact with a great number of dentists of all specialties on the topic of anesthesia. Interest always piqued with the word “complication,” so that fueled the content of this project. Over the past 32 years, we have accumulated a fair amount of practice experience, either first hand or by listening to your sometimes painful stories, which many have unabashedly shared. We have learned more than we taught and it is our hope to share all of this information with you. We are grateful and humbled to be among our 43 contributors, who so graciously accepted the invitation to also share their knowledge, experience, and expertise with us.

If but one life can be saved, or one patient managed better, then this book is well worth the effort. We both assiduously embrace the statement: “Patient Safety through Education.” Thank you for your interest and dedication to improving the delivery of anesthesia in the dental office. Our best wishes to your continued successful professional practice.

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Mr. Brian Stafford, who so patiently created many of the illustrations in this book making “comprehension at a glance” an art form.

Unless otherwise indicated, all pictures are courtesy of Dr. Robert C. Bosack.
SECTION 1

Introduction
The delivery of anesthesia in any setting is not without risk. The environment is complex, uncertain, and ever-changing. Human performance of this potentially hazardous task can be unpredictable and imperfect, especially in times of urgency, intensity, and time pressure. Risk and human error cannot be eliminated, but can be reduced and managed by eliminating a culture of blame and punishment and replacing it with a culture of vigilance and cooperation to expose and remediate system weaknesses, which, in combination, often lead to error and injury.

The concept is straightforward. Most patients do not enjoy going to the dentist. Although patients understand that pain can be eliminated with local anesthesia, fear and anxiety still fuel avoidance of necessary care. Dentistry has responded to these issues by providing options for various levels of sedation, analgesia, or general anesthesia in the dental office. Usually, all goes well. Patients are satisfied; necessary dental work gets done. Sometimes, however, things do not go well.

Complications (adverse events, sentinel events) are defined as unplanned, unexpected, unintended, and undesirable patient outcomes: death, physical/psychological injury, or any unexpected variation in a process or outcome that demands notice. Errors are deviations from accuracy or correctness, usually, caused by a fault (mistake) for example, carelessness, misjudgment, or forgetfulness. Most errors have no obvious effect on patients, yet most (82%) preventable complications in the past involved human error (Cooper et al., 1978).

Errors are categorized according to persons or systems (Reason, 2000). Person approach refers to individual human error: forgetfulness, inattention, lapses (temporary failure of memory), preoccupation, violation (conscious deviation from a rule), loss of situational awareness, and fixation errors. Human errors lead to specific technical, judgmental, or monitoring mistakes, examples of which are given in Table 1.1. System approach refers to practice conditions: staff training, equipment, schedule density, health history gathering, policies, procedures, checklists, and so on. Latent errors can lay dormant in practices for years, only to be exposed during a triggering event, which then leads to an adverse outcome in a susceptible patient.

Although it is tempting to blame a complication on a single human error (e.g., the practitioner gave the wrong drug and the patient died), seldom is this the case. Most complications are now known to be due to an unfortunate temporal alignment of a series of errors, which results in injury. These errors can arise from multiple sources, which include latent errors (overbooking, failure to update medical histories, failure to check equipment, lack of training, poor communication), psychological precursors (fear of lawsuit, embarrassment), system defects (staff not trained in emergency protocols, failure to use checklists, failure to update medical emergency drugs), triggering factors (loss of airway, unintended drug overdose, hypotension, etc.), atypical conditions (key staff member absent), and outright unsafe acts (lack of knowledge, errors of the moment, ignoring a monitor, failure to address a problem, wrong drug given, etc.)

Scope of errors
Unfortunately, errors are a normal part of human behavior, and their causes are not obscure. Habit intrusion, stress, anger, fatigue, boredom, fear, time urgency, illness, and haste increase the odds of faulty performance.

The extent of errors documented to have contributed to anesthetic complications is great. All six major areas of anesthetic practice are implicated: inadequate pre-anesthetic evaluation, faulty patient selection, poor anesthetic management, inadequate monitoring, hurried recovery, and faulty recognition and inappropriate management of complications. Specific examples of errors are noted in Table 1.2.

The human condition
Homo sapiens is the only species that understands the concept of risk; however, habituation blunts this worry. The sense of having control over risk feeds the illusion of preparedness and prompts feelings of denial – “it won’t happen (to me)”; or “if it happens to me, it won’t be that bad”.

Once the error cascade begins, numerous opportunities arise to stop its progression. Many times, however, these opportunities are ignored. Impending doom, coupled with the high stakes environment and time urgency, overwhelms and short circuits the human mind, which makes the most conservative (not necessarily correct) decision more attractive, ultimately leading to situational paralysis. Individuals with increased “cognitive horsepower” tend to be more susceptible to this shortfall, as worry about legal recourse, shame, and personal doom overpower rational thoughts and interfere with concentration on the task at hand (Bielock, 2010; Figure 1.1). Management of these “necessary fallibilities” is possible with repeated
Table 1.1 Triggering events.

- **Technical**
  - Drug overdose
  - Failed airway management technique
  - Oxygen source disconnection
  - Equipment failure
- **Judgmental**
  - Inadequate patient history
  - Wrong drug/technique
  - Wrong airway management technique
  - Delay or failure to adequately treat abnormality
- **Monitoring/vigilance**
  - Failure to detect abnormality
  - Failure to accept abnormality
  - Alarm “saturation”

Table 1.2 Examples of anesthetic errors (Cooper et al., 1984).

- Loss of oxygen supply (tanks empty, not turned on, tubes disconnected)
- Drug error – wrong drug, wrong dose, syringe swap (unlabeled)
- Wrong choice of airway maintenance
- Careless, lack of vigilance haste
- Faulty information gathering and assimilation
- Lack of preparation, scenario rehearsal
- Poor communication among team members
- Unreliable intravenous access
- Unfamiliarity with drugs

Table 1.3 Examples of anesthetic complications.

- Syncope
- Laryngospasm
- Bronchospasm
- Upper airway obstruction
- Allergy
- Seizure
- Tachycardia/bradycardia
- Cardiac arrhythmia
- Hypertension/hypotension
- Myocardial infarction/cardiac death
- Malignant hyperthermia
- Aspiration
- Post-anesthetic recall of intraoperative awareness

Figure 1.1 Performance decrement at extremes of arousal. Adapted from (Bielock, 2010).

practice under stress, periodic “pauses” to collect thoughts, a focus on outcome rather than mechanics, continual self-assurance of one’s ability, and the use of memory guides.

Currently, there is a national focus on checklists (Gawande, 2009) as part of a cognitive safety net to provide protection against necessary fallibility by outlining the minimum necessary steps, especially important during times of adversity and complexity, when worry short-circuits the brain.

Scope of complications

The dental community provides a wide range of anesthesia: local anesthesia only, local anesthesia with nitrous oxide, enteral sedation, parenteral sedation, and anesthesia. It naturally follows that the complications associated with these techniques are also highly variable. These complications range from inability to anesthetize, failed sedation, syncope, and pressure or rhythm disorders to hypoxia and death.

It remains impossible to accumulate complete data on the nature and frequency of anesthetic errors/complications in the dental office. Errors are often managed without patient injury. Most dental anesthetics are administered in private practices (often by solo practitioners) which have sparse reporting requirements. Voluntary reporting is stifled due to fear of further inquiry and punishment. Learning from errors including changing of systems does not occur. Insurance companies also have no obligation to report closed claims, and many malpractice cases are settled and sequestered.

Perianesthetic complications are rare in the dental office, with most reports showing similar data. Perrott et al. (2003) reported on a prospective study of 34,391 ASA I and II patients and showed a complication rate of 1.3 per 100 cases. These included, in approximate order of decreasing frequency, vomiting, laryngospasm/bronchospasm, prolonged recovery, vascular injury, syncope, arrhythmia, seizure, and neurologic impairment. D’Eramo et al. (2008) reported similar complication rates from a survey of 169 oral and maxillofacial surgeons. Other examples of complications are noted in Table 1.3. However, a true mortality rate is not readily obtainable. The most current data from OMSNIC (the malpractice insurance company that covers approximately 80% of US oral and maxillofacial surgeons) estimates the likelihood of an office-anesthetic-related death to be 1/365,554 anesthetic cases (Estabrooks, 2011).

The prevention, diagnosis, and management of anesthetic complications are the focus of this book, and are addressed from multiple perspectives. Patient evaluation and selection, with emphasis on common comorbidities, knowledge of drug action, limitations of office-based anesthesia, monitoring, and preparation and management of adversity are addressed. Crisis resource management during error/complication evolution is not taught in dental school or residency programs. It is included here as the most important asset for complication management.

**References**


Estabrooks, L. Redefining the standards of office anesthesia: supporting data to adapt higher standards. Presented at the 93rd AAOMS annual meeting, Philadelphia, PA, 2011.


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Introduction

The risks associated with office-based anesthesia are greater than the risk of dental surgery. Preanesthetic patient evaluation and appropriate case selection maximize safety, efficacy, and efficiency of office-based anesthesia and surgery. It provides a basis for case refusal or limit setting on the depth of anesthesia.

Accurate patient evaluation requires effective communication with patients by ensuring complete patient comprehension by “repeat back” questions, enhanced listening skills of the doctor, and effective team communication. Unfortunately, some patients will be less than forthright in disclosing their diseases or medication adherence. In other cases, patients may be unaware of their disease or will have yet-to-be-diagnosed disease. Suspicion of any disease in the dental patient should help diagnosis and trigger appropriate referral as necessary.

Cardiovascular, pulmonary, and upper airway complications are three major causes of morbidity and mortality in the dental office. Together with NPO status, these comprise the core elements of preanesthesia patient evaluation.

The American Society of Anesthesiologists recommends the following sequence for preoperative evaluation:

- Patient interview and review of the medical/surgical/anesthetic history
- Physical examination
- Assigning of an ASA physical status score
- Formulation and discussion of the anesthetic plan

Consideration of the anticipated physiologic and anatomic disruptions of both surgery and anesthesia is the first aspect of patient evaluation. Preoperative patient evaluation is an opportunity to identify previously diagnosed diseases; to assess patients for signs and symptoms of occult diseases; to determine the need for focused preoperative laboratory or diagnostic studies; and to review patient medications. This is done in order to preoperatively optimize the patient and prevent exacerbation of existing disorders. Ultimately, this will guide decisions regarding refusal of anesthesia, limit setting on the depth of anesthesia, and location of care. This process is called risk assessment.

The ASA physical status is assigned to a patient in order to stratify the risk of the anesthesia and planned surgery. In the operating room setting, where the majority or anesthetics are given, the ASA score (Table 2.1) is known to correlate with morbidity and mortality, unplanned ICU admissions, longer hospital stays, and adverse cardiopulmonary outcomes (Sweitzer et al., 2008). Though the majority of outpatient dental procedures may be minor in comparison to an inpatient surgical procedure, the anesthetics given (and thus the risk profile) in either setting may be similar.

Cardiovascular risk assessment

History

Direct office-based anesthetic cardiovascular risks include adverse heart rate and blood pressure changes, with tachycardia and hypotension being more worrisome in the adult patient. Patients with coronary artery disease (diagnosed or undiagnosed) are less able to tolerate increased oxygen demand associated with tachycardia. Any decrease in oxygen delivery to vital organs, due to a decrease in cardiac output or blood pressure, is also worrisome.

Cardiovascular evaluation for dental patients undergoing office-based anesthesia is used to screen those patients with major issues who will benefit from further testing and disease optimization management prior to surgery and anesthesia. The presence of “minor” symptoms also may prompt a delay in office-based anesthesia, pending further evaluation.

Direct questions should screen for the presence of preexisting diseases, including hypertension, coronary artery disease, prior myocardial infarction, heart failure, arrhythmias, valvulopathy, hyperlipidemia, and prior cardiac intervention (stents, bypass grafts, cardiac implantable electronic device). Physical symptoms of angina, shortness of breath, level of exercise tolerance, palpitations, irregular heartbeat, cough, dizziness, orthostatic hypotension, syncope, smoking, sedentary life style, and family history of sudden cardiac death are significant findings (Table 2.2). The patient’s medication list can also provide insight into the presence of disease state.

Case selection and management are guided by estimates of patient resilience and patient reserve. Resilience refers to the patient’s ability to tolerate hypoxia and heart rate and/or blood pressure changes without decompensation. The ability to tolerate adversity depends on both the duration and the severity of the challenge. As an example, a patient with obesity and coronary artery...
disease is challenged by decreased functional residual capacity (due to cephalad displacement of the diaphragm, especially during anesthesia) leading to quick onset hypoxemia with apnea and an inability to tolerate the subsequent sustained tachycardia. Reserve refers to the ability to physiologically compensate hypoxemia and/or adverse cardiovascular changes via arousal and ventilatory and/or cardiovascular changes. As examples, the elderly may be unable to compensate for hypoxemia with tachycardia, while the infants have an invariable stroke volume and will be unable to tolerate a bradycardia.

Cardiovascular disease (hypertension, atherosclerosis (coronary artery disease, CAD, and ischemic heart disease), valvulopathy, heart failure, and rhythm disorders) affects up to one-third of patients presenting for dental care, which puts them at increased risk for cardiovascular complications (Pasternak, 2002). As “Baby Boomers” age and thresholds for performing procedures on the elderly ease, increased numbers of patients with cardiovascular disease will be presenting for dental care under anesthesia.

Goldman et al. (1977) was the first to prospectively evaluate 1001 patients over age 40 who underwent non-cardiac surgery. They documented nine preoperative variables that were associated with a higher risk of cardiac events in the perioperative period. These findings, revised in 1999 by Lee (known as the Revised Cardiac Risk Index), led to the 2007 American College of Cardiology/American Heart Association guidelines on perioperative cardiovascular evaluation for non-cardiac surgery (Fleisher et al., 2007). These guidelines help estimate the risk of a cardiac event during non-cardiac surgery, help define risk with selective testing, suggest intervention to lower risk as necessary, and assess long-term risk and modify risk factors. Three elements are assessed to determine the extent of risk – the presence of active cardiac conditions, exercise capacity, and surgery-specific risk (Table 2.3). This algorithm suggests immediate referral and refusal of all elective surgery for patients with active cardiac conditions and referral and refusal for intermediate risk surgery for patients who cannot function at least at a 4 MET level. Further action or referral for patients without active cardiac conditions and low risk surgery (office-based dental surgery) is seldom required.

There are, however, other factors that can introduce unnecessary risk during office-based anesthesia (Kheterpal et al., 2009). These factors include age >68 years, BMI > 30 kg/m², previous cardiac intervention, cerebrovascular disease, hypertension, and operative duration >3.8 hours. Obesity, obstructive sleep apnea, and diabetes mellitus are also strongly associated with cardiovascular disease.

### Cardiovascular examination
Core elements of cardiovascular examination include inspection, palpation, and auscultation. Vital signs, including blood pressure,

### Table 2.1 ASA physical status score (American Society of Anesthesiologists, available at www.asahq.org).

| ASA I | Healthy patient without organic, biochemical, or psychiatric disease |
| ASA II | Mild systemic disease, without significant impact on daily activity, e.g., mild asthma or well-controlled hypertension. Unlikely impact on anesthesia and surgery |
| ASA III | Significant or severe systemic disease that limits normal activity. Likely impact on anesthesia and surgery |
| ASA IV | Significant and severe systemic disease that is a constant threat to life. |
| ASA V | A moribund patient that is not expected to survive without the operation |
| ASA VI | A patient declared brain-dead whose organs are being harvested for donation |

### Table 2.2 Significance of screening questions.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Select cardiovascular concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atherosclerosis, coronary artery disease (CAD)</td>
<td>Increased cardiac workload, aortic stenosis limits cardiac output</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Increased cardiac workload, known risk factor for CAD, MI, HF; perianesthetic hypotension</td>
</tr>
<tr>
<td>Prior myocardial infarction (MI)</td>
<td>Increased cardiac workload, known risk factor for CAD, MI, HF; perianesthetic hypotension</td>
</tr>
<tr>
<td>Heart failure (HF)</td>
<td>Post infarct irritability, arrhythmia, re-infarction with recent MI (&lt;30 days)</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>Level of compensation, exercise tolerance</td>
</tr>
<tr>
<td>Valvulopathy</td>
<td>Level of control, side effects of anti-arrhythmic medication, symptoms, possibility of recurrence during anesthesia</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>Increased cardiac workload, aortic stenosis limits cardiac output</td>
</tr>
<tr>
<td>Prior cardiac intervention – stents, bypass, CIED</td>
<td>Atherosclerosis, CAD</td>
</tr>
<tr>
<td>Angina</td>
<td>Stent re-thrombosis, compliance with anti-platelet therapy, device efficacy, battery life</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>Never normal, could indicate coronary artery disease</td>
</tr>
<tr>
<td>Level of exercise tolerance</td>
<td>Never normal, non-specific symptom, cardiac and/or pulmonary origin</td>
</tr>
<tr>
<td>Palpitations; unprovoked episodic tachycardia</td>
<td>Should be able to take care of self, ascend one flight of stairs (4 METS)</td>
</tr>
<tr>
<td>Irregular heart beat</td>
<td>Atrial fibrillation, PVCs, supraventricular tachycardia</td>
</tr>
<tr>
<td>Cough</td>
<td>Atrial fibrillation, PVCs</td>
</tr>
<tr>
<td>Dizziness</td>
<td>Non-specific symptom, decompensated heart failure, COPD</td>
</tr>
<tr>
<td>Orthostatic hypotension</td>
<td>Atrial fibrillation, PVCs</td>
</tr>
<tr>
<td>Syncope</td>
<td>Side effect of anti-hypertensive medications</td>
</tr>
<tr>
<td>Smoking</td>
<td>Atherosclerosis, COPD, increased airway irritability, sympathomimetic, falsely elevated SpO₂</td>
</tr>
<tr>
<td>Sedentary life style</td>
<td>Atherosclerosis, obesity</td>
</tr>
<tr>
<td>Family history of sudden cardiac death</td>
<td>Hereditary long QT syndrome</td>
</tr>
</tbody>
</table>